GCC In Depth
Session 304
AppearanceSample
Context
GetThemeBrushAsColor
GetThemeBrushAsColor(

GCC In Depth

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Introduction

- GCC :: Apple's compiler
- Partnerships
- Future directions

The Challenge…

GCC

- Open Source with large community involvement
- Solid industry standard compiler
  - Billions of lines of user code compiled
  - Large and growing regression test suite
  - Across many platforms

What Does Apple Contribute…

- Objective-C / Objective-C++ care and feeding
- New optimizations
- Compilation speed enhancements
- General maintenance

About the GCC 3.3 Release…

- Language features
- Compile speed
- Code quality

Language Features

- C / C++ Standards compliant
  - Wide-Character support
- Objective-C / Objective-C++ Exception Model
- CodeWarrior compatible inline assembly

3.1 Compiler Compatibility

- C++ / Objective-C++ ABI changed
- cpp-precomp not available in GCC 3.3
- PFE not available in GCC 3.3
- GCC 3.3 warns on invalid compiler options
- -traditional-cpp definition changed to match GCC
- -nostdinc means don’t search *any* system directories

GCC Compile Speed…

Precompiled Headers

Carbon.h.gch

BevelDialog.cp

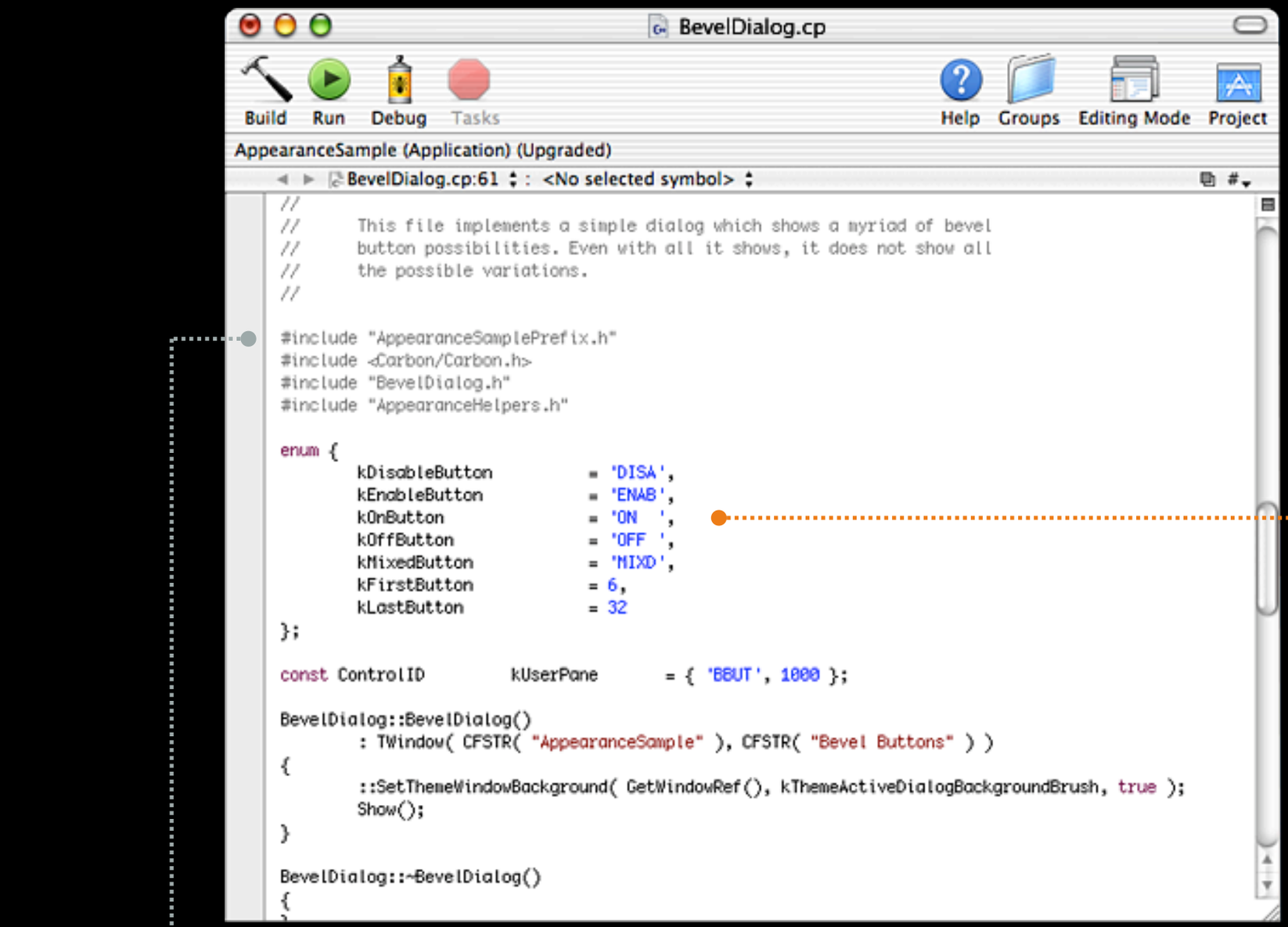
Build Run Debug Tasks Help Groups Editing Mode Project

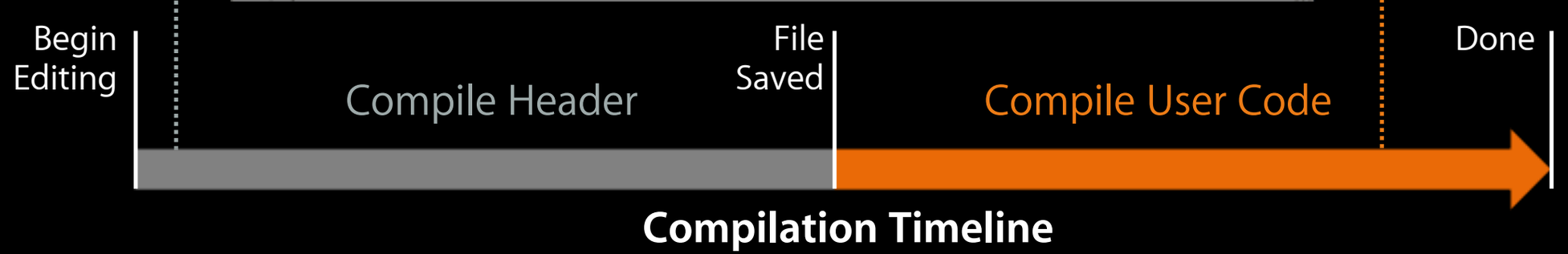
AppearanceSample (Application) (Upgraded)

BevelDialog.cp:61 : <No selected symbol>

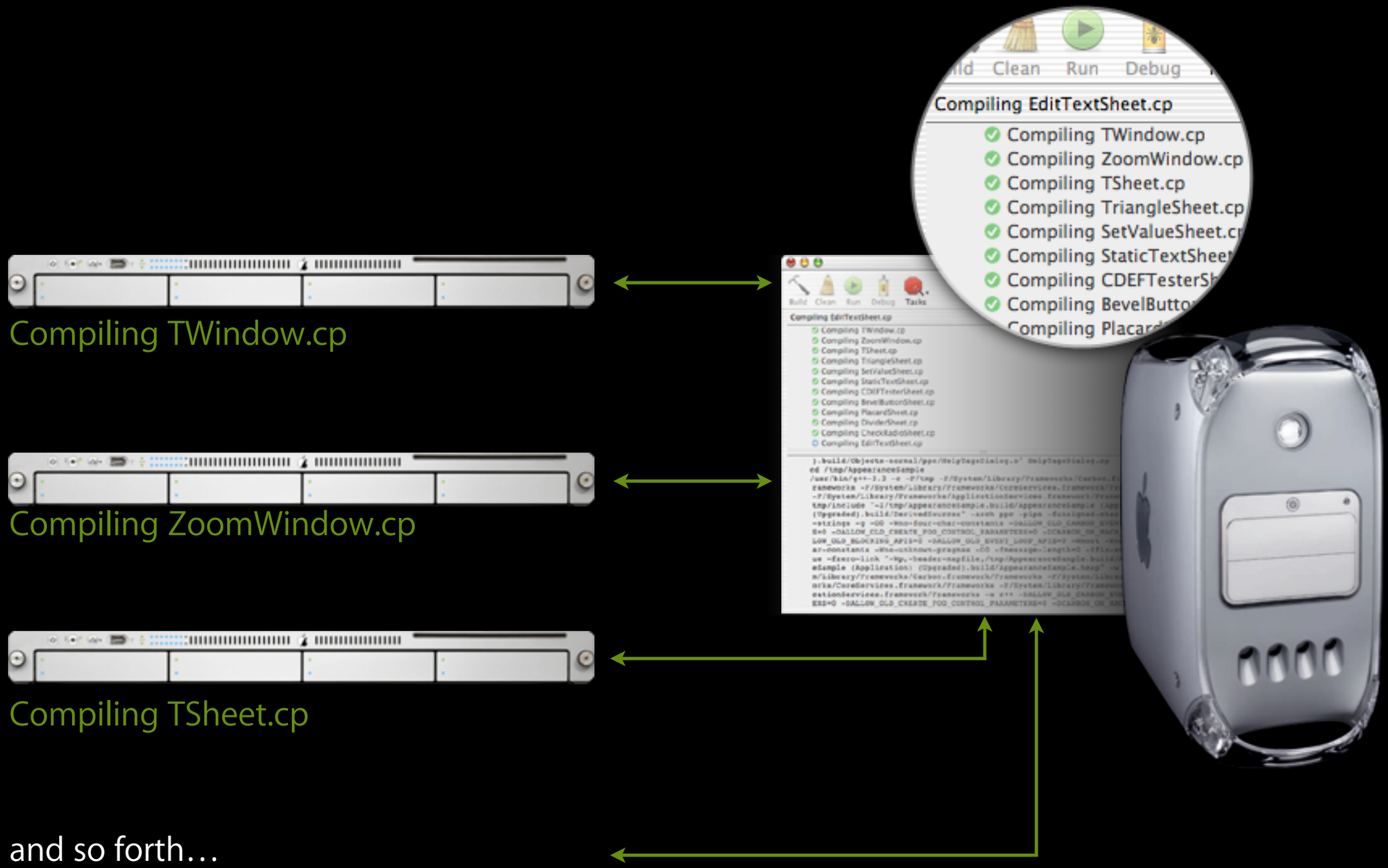
```
//
//      This file implements a simple dialog which shows a myriad of bevel
//      button possibilities. Even with all it shows, it does not show all
//      the possible variations.
//

#include "AppearanceSamplePrefix.h"
#include <Carbon/Carbon.h>
#include "BevelDialog.h"
#include "AppearanceHelpers.h"

enum {
        kDisableButton          = 'DISA',
        kEnableButton           = 'ENAB',
        kOnButton               = 'ON  ',
        kOffButton              = 'OFF ',
        kMixedButton            = 'MIXD',
        kFirstButton            = 6,
        kLastButton             = 32
};

const ControlID         kUserPane       = { 'BBUT', 1000 };

BevelDialog::BevelDialog()
        : TWindow( CFSTR( "AppearanceSample" ), CFSTR( "Bevel Buttons" ) )
{
        ::SetThemeWindowBackground( GetWindowRef(), kThemeActiveDialogBackgroundBrush, true );
        Show();
}

BevelDialog::~BevelDialog()
{
```

Predictive Compilation



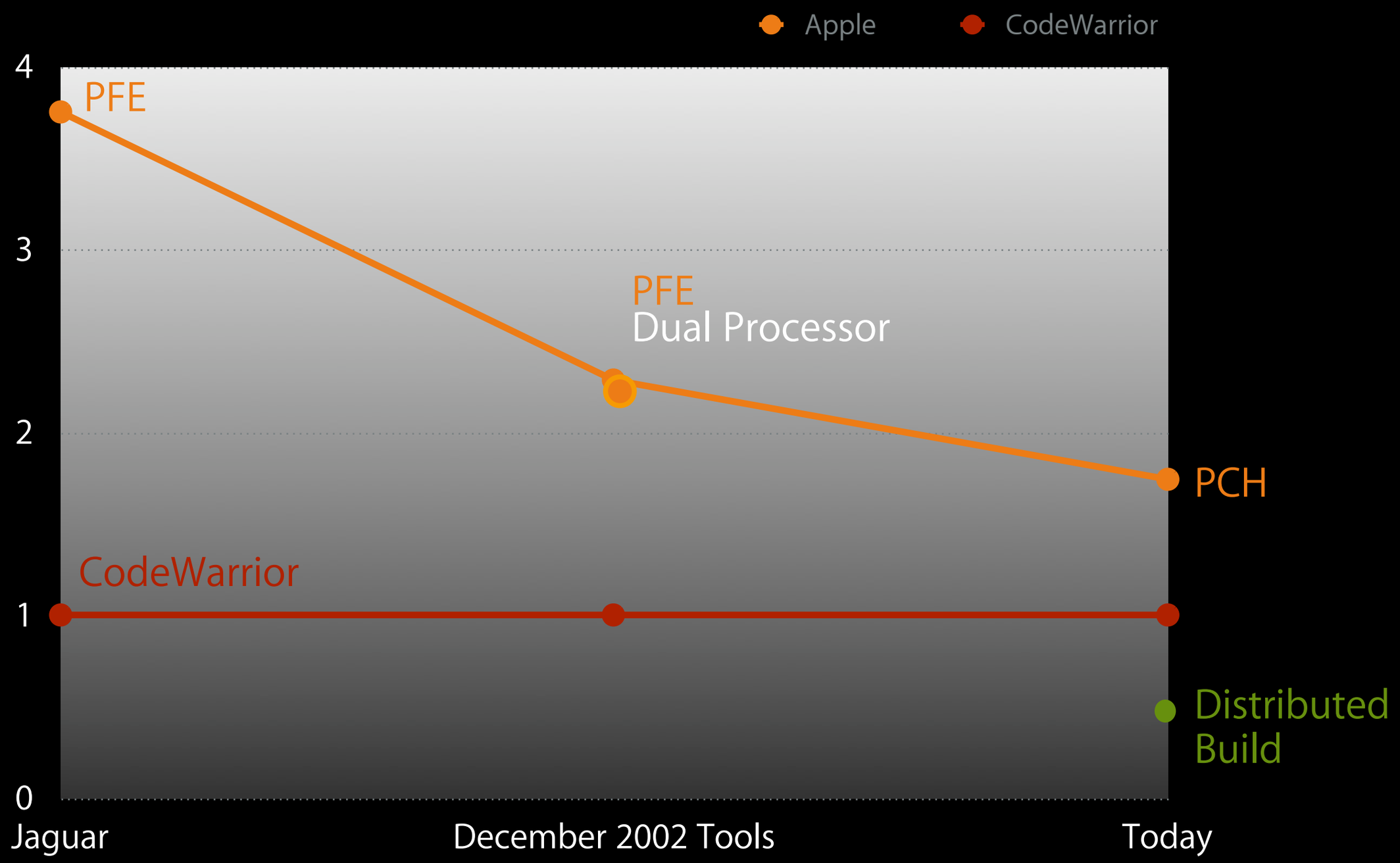


Distributed Compilation



and so forth…

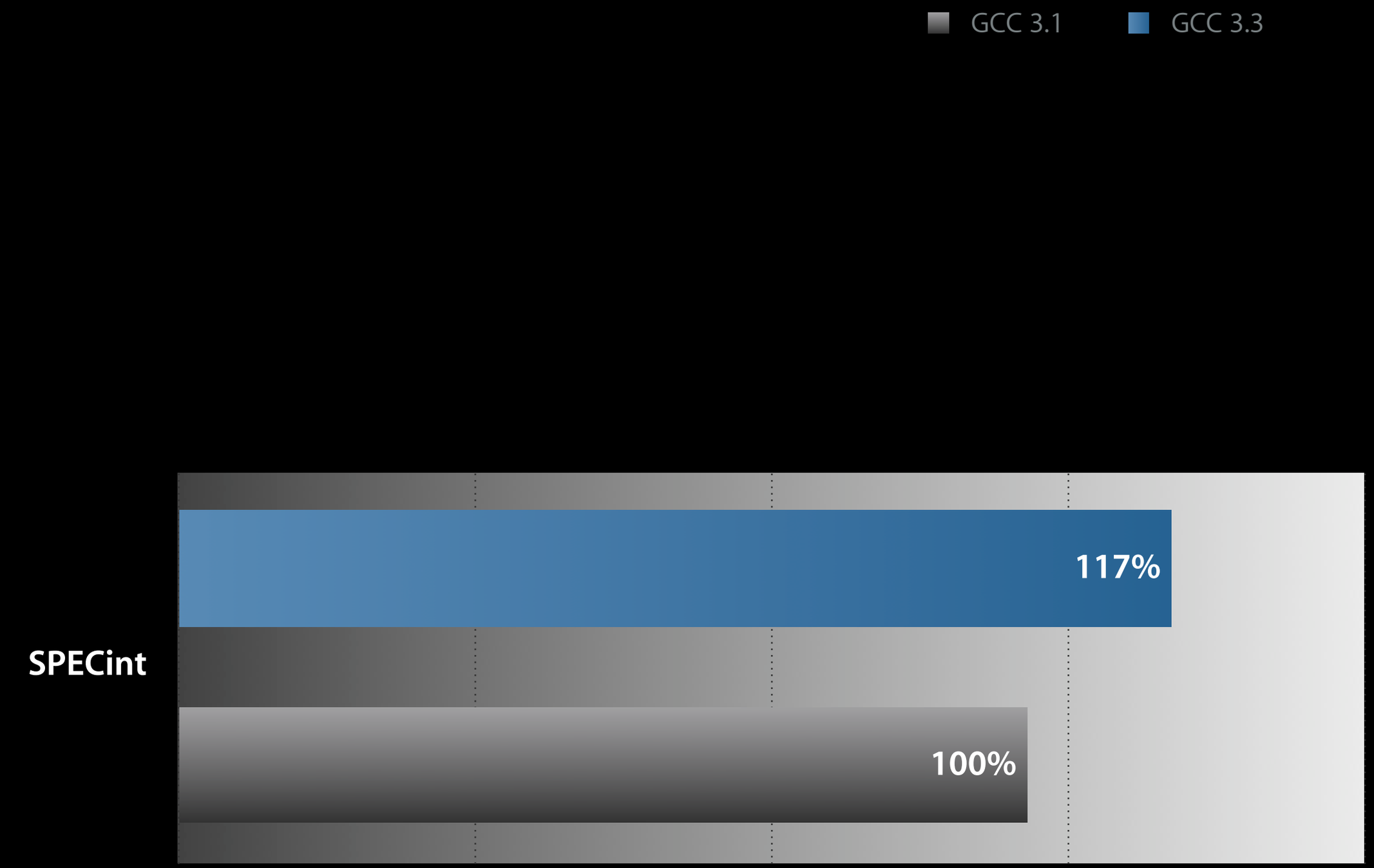
Compile Speed Improvements



Code Quality

- Benchmarking

G5 Performance



Power Mac G5 2Ghz Single Processor

Taking Advantage of G5…

- Compiler options
  - -mcpu=G5
  - -mtune=G5
  - -mpowerpc64
  - Use -O2 or -O3 to obtain best performance
  - Alignment of loops, jumps and functions

IBM Partnership

David Edelsohn
IBM Research

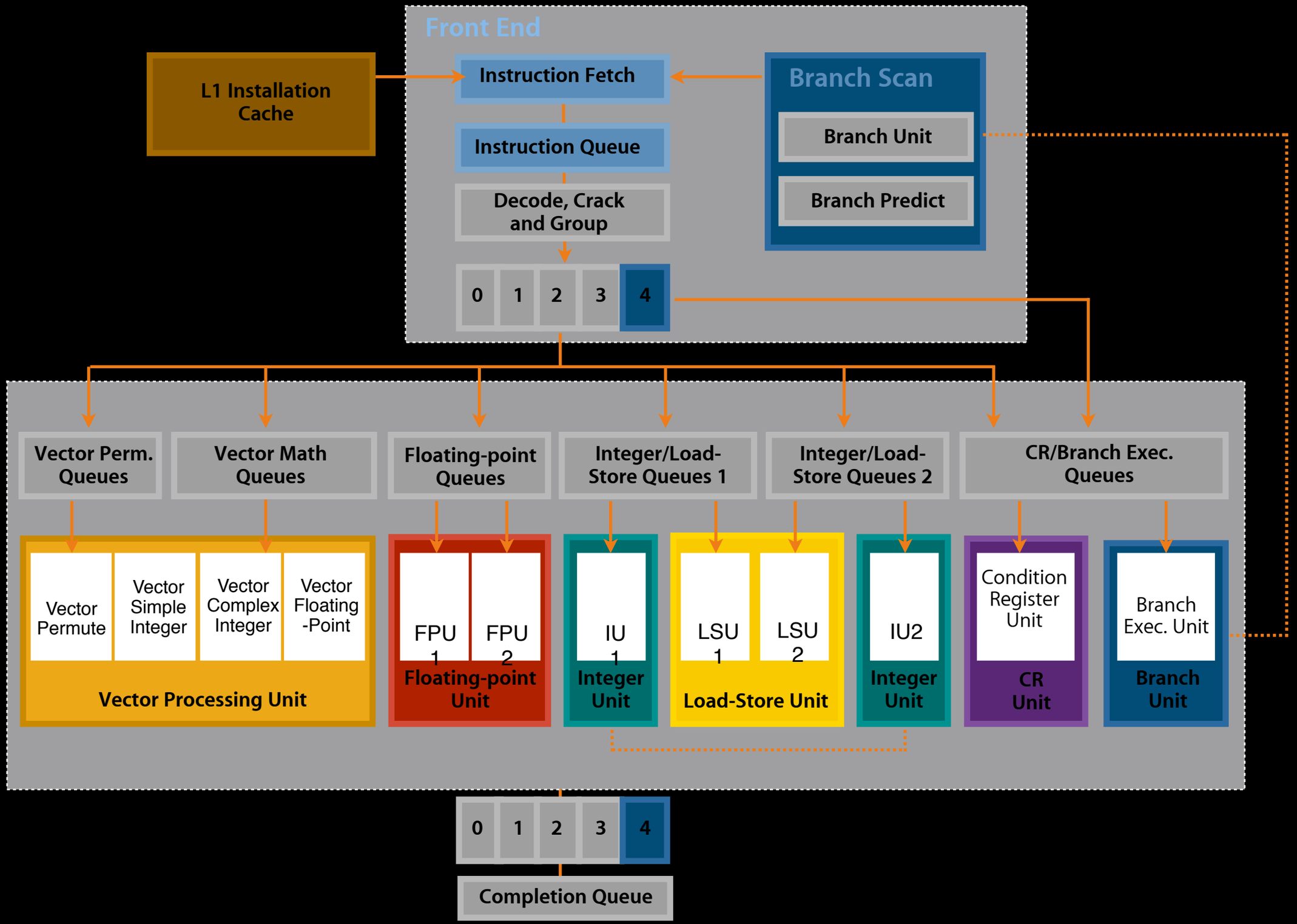
Outline

- PowerPC 970 processor
- Tuning GCC
- Planned optimizations
- Apple, IBM, and Open Source community

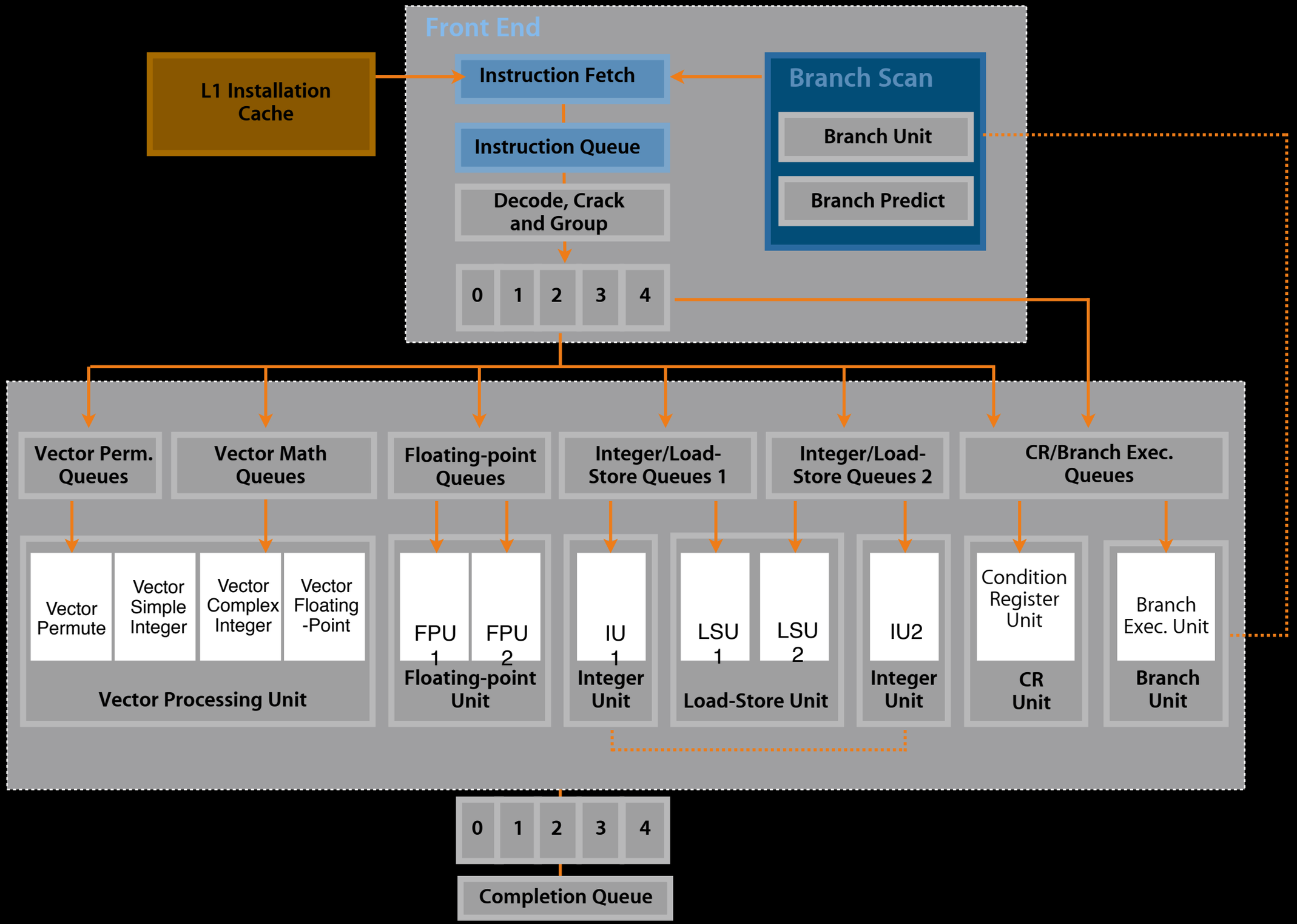
PowerPC 970 Versus G4

- 64-bit natural extension to 32-bit PowerPC architecture
- 32-bit and 64-bit modes with identical performance
- 2 symmetric FPUs, not 1
- 2 symmetric LSUs, not 1
- 2 (almost) symmetric IUs
- Increased resources = boost to performance

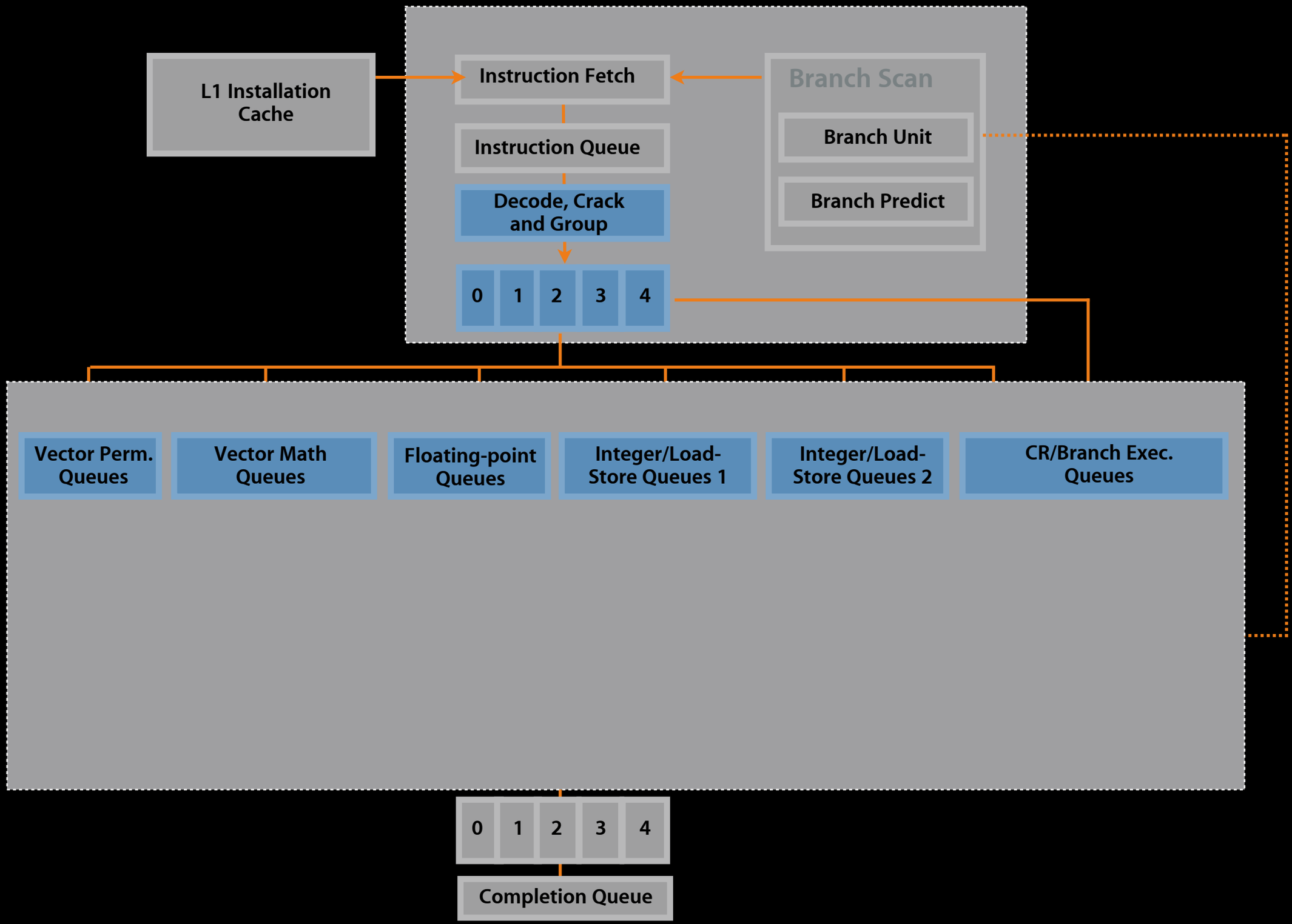
PowerPC 970 Functional Units



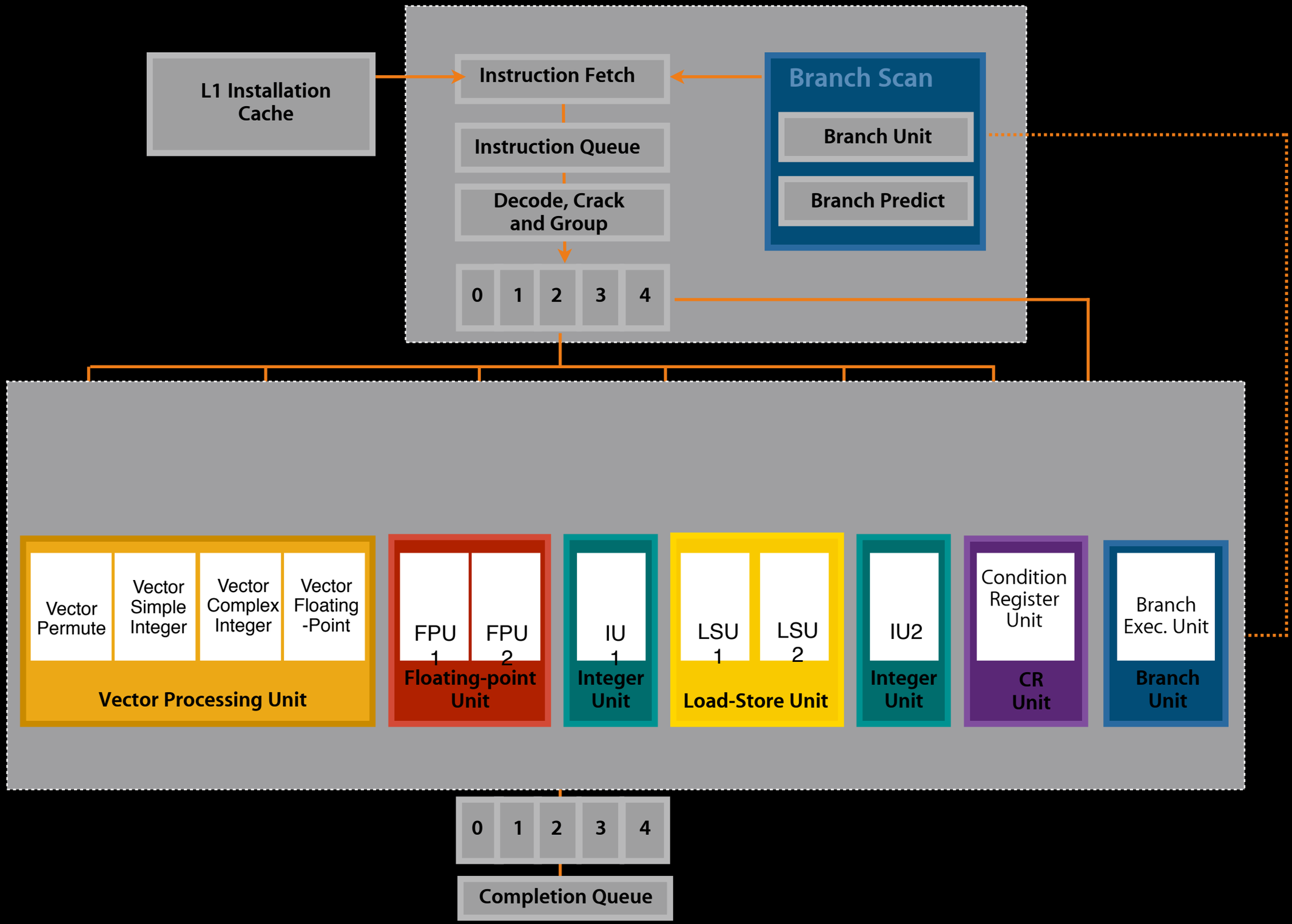
PowerPC 970 Functional Units



PowerPC 970 Functional Units



PowerPC 970 Functional Units



PowerPC 970 Complexity / Challenges

- iops (internal ops)
  - Most match PowerPC instructions 1:1
- Instruction cracking
  - Load algebraic
  - Load update
  - Stores
  - Implicit compares
  - Multi-field condition register ops
- Dispatch group restrictions
- In-order dispatch, out-of-order issue

Tuning Code for PowerPC 970

- Prefer non-cracked instructions
- Dispatch groups
  - Maximize group dispatch and group completion
- Balance dual function unit usage
- Separate dependent instructions
- Branch-to-branch dependency
- Branch link queue
- Alignment

To Tune or Not To Tune

- Detailed tuning for best performance
- G4 code will run well
- PowerPC 970 not finicky

How To Help Compiler

- Simplify memory accesses
  - Use local variables
  - Avoid taking address of variables
- Simplify loops
  - Avoid branches inside loops
- Simplify array index use
- Obey type rules

IBM Compiler Technology

- World-wide research and development organization
- Decades of experience with compiler development
- IBM Compiler enhancements developed for PowerPC 970 core (POWER4 core)
  - Dispatch group scheduler
- Driving knowledge, expertise, and optimizations into GCC
- Enhancing GCC to exploit PowerPC 970-specific features

GCC Development Futures

- New register allocator
- Improved instruction scheduler
- Software pipelining
- SSA optimization infrastructure
  - Loop optimizations
  - Auto-vectorization
- Interprocedural optimizations
- Profile feedback-directed optimizations
- Faster compilation speed

Apple and IBM

- Partnership
  - Commitment to GCC and to Open Source
  - GCC developers
  - PowerPC port maintainers
  - GCC steering committee members
  - Full collaboration with GCC community
- Leadership in Open Source community

The Excitement Is Just Beginning…

Thanks Jon “Hannibal” Stokes

Wrap Up

Ron Price

Future Apple Directions

- Language features
- Compile speed
- Code quality

How to Learn More

- Part of Xcode tools package
  - Use the Documentation window and search features
  - GCC 3.3 Release Notes
- Apple Developer Connection tools pages
  http://developer.apple.com/tools/

Who to Contact

Godfrey DiGiorgi
Technology Manager, Development Tools
ramarren@apple.com

Development Tools Engineering Feedback
xcode-feedback@group.apple.com

To Post Bug Reports
http://developer.apple.com/bugreporter

Mailing Lists at Apple
http://lists.apple.com

http://developer.apple.com/wwdc2003/urls.html

Roadmap

305 Tuning with Performance Tools
Learn to use the tools and improve performance

The Presidio
Wed., 5:00pm

306 AppleScript Studio
Explore professional AppleScript development

Pacific Heights
Wed., 5:00pm

307 Apple Tools for Carbon Development
See how Carbon is supported by Xcode

Russian Hill
Thur., 9:00am

FF009 Dev Tools Feedback Forum
Give us your feedback

North Beach
Thur., 2:00pm

308 Debugging Services for Mac OS X
Hear the latest in debugging for Mac OS X

The Presidio
Thur., 3:30pm

Q&A

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http://developer.apple.com/wwdc2003/urls.html

WWDC 2003

Worldwide Developers Conference